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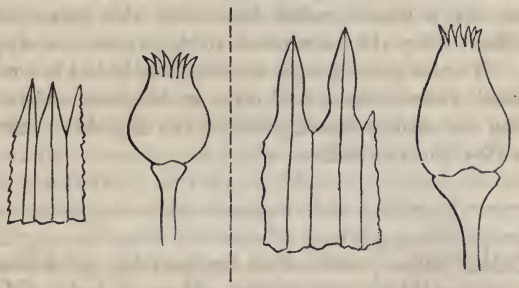
L. dioica, *α. Linn. Sp. Pl.* 626. *Sm. Eng. Fl.* 2. 328. *Eng. Bot.* t. 1579.
L. diurna. *Sibth. Oxon.* 145. *Koch. Syn.* 107.
L. sylvestris, "*Hoppe*" *DeCand. Prod.* 1. 386.

Flowering in May and June. Flowers usually red; rarely nearly white. The length of the teeth of the calyx is variable, but I believe the form to be constant.



L. diurna, *Sibth.* L. vespertina, *Sibth.*

2. *L. vespertina* (Sibth.). Petals half bifid crowned, leaves, peduncles and calyces hairy, leaves ovate-lanceolate, flowers dichotomously panicled dicœcious, teeth of the calyx linear-lanceolate elongated, capsule conical with erect teeth.

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St. John's Coll. Cambridge, July 29, 1840.

XI.—*Some Observations on the Origin and Direction of the Woody Fibre of the Stems of Palms.* By George Gardner, Esq., Surgeon*.

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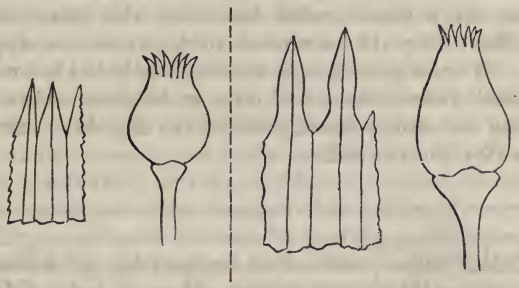

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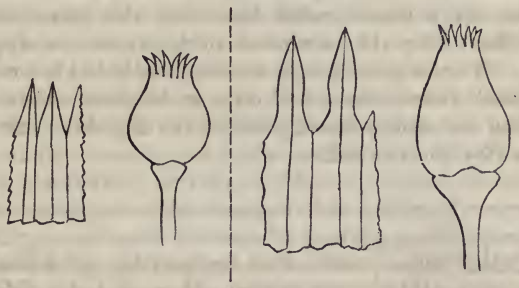

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culations of the most interesting nature in the mind of the philosopher, and enable him by induction to give a definite and harmonious idea of the former condition of the globe. It was only from the intimate knowledge which the immortal Cuvier possessed of the anatomical structure of the living animals which now people the earth, that he derived the power of giving all but life to a host of its former inhabitants, whose existence and real characters were before totally unknown. If such knowledge is requisite for throwing light on the remains of animals, it must be obvious that the relics which survive of the extinct vegetation of the earth can only be successfully investigated by those who have attentively studied the anatomical structure of that which now covers its surface. To the geologist, knowledge of this kind must be of the utmost value, since we now know that many tribes of plants are as readily distinguished by the structure of their stems, as by the characters which are given to them by their organs of fructification. Thus all the individuals of the natural order *Coniferæ* are immediately recognized by there being scarcely any mixture of vascular tissue among the woody fibre of their stems, as well as by their ligneous tissue being marked with circular discs, which are supposed by Kieser and several other vegetable physiologists to be pores, but which, from apparently good reasons, Dr. Lindley considers to be semitransparent granules. *Cycadeæ* are recognized by the same want of vascular tissue as in *Coniferæ*, and by their wood being marked in the same manner; but the zones of wood are separated by a layer of cellular substance resembling that of the pith, and often as thick as the zones themselves. The shrubs which constitute the natural order *Calycantheæ* have square stems, with four woody imperfect axes, surrounding the usual central one; and the investigations of those who are now devoting themselves to such inquiries may probably lead to the discovery of distinguishing characters in the stems of other well-marked tribes of the vegetable kingdom.

These remarks have been occasioned from reading the account of the anatomical structure of *endogenous plants* given by Dr. Lindley in his 'Introduction to Botany.' After stating the general plan on which the stems of these plants are formed, the following paragraph occurs at page 82 of the second edition of that work: "The investigations of Mohl appear to show that this view of the structure of *endogens* requires some modification. According to this observer, every one of the woody bundles of a palm-stem originates in the leaves, and is at first directed towards the centre; arrived there, it follows

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the course of the stem for some distance, and then turns outward again, finally losing itself in the cortical integument. In the course of their downward descent the woody bundles gradually separate into threads, till at last the vascular system, which for a long time formed an essential part of each of them, disappears, and there is nothing left but woody tissue. In this view of the growth of *endogens*, the trunk of such plants must consist of a series of arcs directed from above inwards, and then from within outwards; and consequently the woody fibres of such plants, instead of being parallel with each other, must be interlaced in infinite intermixture. There are, however, some difficulties in the way of this theory, which we do not find adverted to by its author. If Mohl's view of the structure of *endogens* be correct, they must after a time lose the power of growing, in consequence of the whole of the lower part of their stems being choked up by the multitude of descending woody bundles. Is this the case? The lower part of their bark, too, must be much harder, that is, much more filled with woody bundles than the upper. Is that the fact? The hardness of the exterior of palm-stems cannot be owing to the pressure of new matter from within outwards, but to some cause analogous to the formation of heart-wood in exogens. Is there any proof that such a cause is in operation? I mention these things," continues Dr. Lindley, "not so much from distrust of Mohl's views, as from a desire to see the difficulties which seem to lie in the way of an ingenious theory satisfactorily removed."

At the time of reading this I was prosecuting my botanical researches on the Organ Mountains of Brazil; and having ample opportunity for making observations on the subject, from the great number of individuals of the palm tribe which are found on this range, of all sizes, from the tall species that inhabit the plains, to the dwarf ones which are met with at an elevation of upwards of 5000 feet, I determined to ascertain whether or not the views of Mohl, as stated by Dr. Lindley, were correct.

The first individual I examined was a large low-growing species, called by the Brazilians *Coqueiro*. The stem measured $4\frac{1}{2}$ feet in circumference, and the leaves were inserted at the distance of 3 inches from each other. Having caused a longitudinal section of the stem to be made, both through the portion destitute of leaves, and that to which the leaves were attached, the bundles of woody fibre were distinctly seen passing from the scars and the bottoms of the leaves downwards and inwards to the middle of the stem at an angle of 18°. The individual fibres being large in this species, I was

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able to trace their course with great ease. I found that after entering the stem they made a gentle curve downwards and inwards till they reached nearly the centre of the column; then, changing their direction, they turned downwards and outwards, with a greater degree of obliquity than before, till they reached within a little of the external surface of the stem, after which they continued to descend in a line parallel with its axis, ultimately becoming so much ramified that I was unable to trace them. The chord of the arc, or the distance from the place where the fibres entered the stem, to the point where they finished their curve, was $2\frac{1}{2}$ feet. I was not only able to trace the fibres as above described, but could also trace them from the interior of the stem for a considerable distance up into the substance of the leaf itself.

Longitudinal sections of the stems and leaves of the cabbage-palm (*Euterpe edulis*, Mart.), of a very tall species, called by the Brazilians *Patí*, and of a small one which they call *Oricana*, all exhibited precisely the same structure, the length of the curve of the fibres only differing according to the thickness of the stems of the different individuals and the distance between the insertion of the leaves.

The stems of all the species split with difficulty, owing to the great mesh-work of interlaced fibres.

Having thus shown that the views of Mohl regarding the origin and direction of the woody fibre of the stems of palms are quite in accordance with what I have myself observed, I shall now make a few remarks on the objections, or rather doubts, which Dr. Lindley has expressed concerning them. In the first place, he says, "if Mohl's view of the structure of *endogens* be correct, they must after a time lose the power of growing in consequence of the whole of the lower part of their stems being choked up by the multitude of descending woody bundles. Is this the case?" In none of the oldest palm-trees which I have seen cut down did it seem that this would ever be the case, the stem always exhibiting a like thickness of external hard, and internal soft portions, from the root to a height of many feet; and that this ought to be the case, is obvious from their structure. As the bundles of woody fibre originate from the leaves, and as they are placed the one above the other on the stem, it follows that the fibres of the upper leaves will not descend so far as those of the lower, and that, consequently, as the stem increases in height so will the density of its sides increase upwards also. In the second place, he says, "the lower part of their bark, too, must be much harder, that is, much more filled with woody bundles than the upper. Is that the fact?" Every one who has been in the

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habit of seeing old palms cut down knows this to be the fact. When the axe is laid to the bottom of some of these old stems, it rebounds from them as if it were striking a piece of iron, while the upper part can be cut through with the greatest facility. Every Brazilian is aware of this fact. So durable is the wood of the large species of palm which they call *Patí*, that they prefer it to most other wood for supports to their houses, which in the country are generally built of wood, but it is only the lower, never the upper portion of the stem that they choose. The explanation given above will also account for this fact. In the third place, he says, "The hardness of the exterior of palm-stems cannot be owing to the pressure of new matter from within outwards, but to some cause analogous to the formation of heart-wood in *exogens*. Is there any proof that such a cause is in operation?" Before replying to this, I may observe, that the opinions of vegetable physiologists are still unsettled regarding the formation of wood in exogenous stems; Lindley, and others, maintaining the opinion of Du Petit Thouars, that the wood of a plant is formed by the multitude of leaf-buds by which it is covered, each of which may be considered a fixed embryo, having an independent life and action—that by its elongation upwards it forms new branches, and by its elongation downwards it forms wood and bark;—whilst DeCandolle, and most of the French physiologists, explain its formation by the hypothesis, that new layers are developed by pre-existing layers, which are nourished by the descending juices formed in the leaves. In palms, a longitudinal section of their stems, with the leaves still attached to them, only requires to be seen to convince the most sceptical that the ligneous substance of them is formed by the leaves, and this affords another proof, at least an analogical one, to the many which have already been given, that the wood of *exogens* originates in the leaves. The only difference between the formation of these two kinds of stems seems to be, that in the exogenous tribes the woody fibre always remains between the bark and the last-formed layer of wood; while in the stems of palms the bundles of woody tissue pass downwards and *inwards* to the interior of the stem, then gradually downwards and *outwards*, and finally descend parallel with the axis of the stem, through the previously formed tissue of the same nature.

Organ Mountains, Brazil, May 28, 1837.

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